Annex 4 - Assessing the options

Basic options and setting the baseline

Determining the 'basic' options

1.1. In our November 2017 Working Paper[1], we set out that our principles-driven assessment of possible options had led us to seven possible charging mechanisms for setting residual charges. Table 1 sets out these options and our reasons for taking the shortlisted options forward. Options coloured green indicate that benefits were identified that prompted further investigation, yellow is neutral and red indicates that these options were not consistent with our decision to levy these charges on final demand consumers only.

Table 1 Characteristics of residual charging options brought forward

Charge	Description	Characteristics	Verdict
Fixed charges	Charges based on a classification class, e.g. user type or profile.	Do not provide incentives for, or against, network use. Avoiding the charge is difficult and only achievable through disconnection. Potential for unfair or regressive impacts where users differ greatly from other members within its group.	Merits further investigation
Gross Volumetric charges	Charges based on volumetric consumption, including that served through on-site generation	Would be expected to drive energy efficiency or disconnection, as no advantage provided by the use of DSR or on-site generation. Many practical barriers.	Merits further investigation for non-domestic users only
Ex-ante capacity charges	Charges based on agreed or connected capacity	Provides incentives for reducing connected capacity, possibly through investment in on-site generation. Incentivises accurate capacity agreements. May appear unfair for users with unused capacities such as domestic customers.	Merits further investigation
Ex-post capacity charges	Charges based on peak capacity use	Reflects use of capacity, rather than option to use capacity. May incentivise reduction in capacity use. Metering capability not present in significant proportion of users.	Merits further investigation

1 https://www.ofgem.gov.uk/system/files/docs/2017/11/tcr_working_paper_nov17_final.pdf

Net Volumetric charges	Charges based on volumetric consumption of electricity from the networks	Provides strong incentives for on-site generation and energy efficiency. May reward users with opportunity to invest in ways to reduce charges.	Not likely to be suitable as sole charging method
Net volumetric import and export charges	Charges for units generated on-site and exported to networks as well as units imported from networks.	Incentive to minimise volumes imported or exported from site, meaning on-site generation advantages are present where well matched to site demand.	Not consistent with demand-only charging for residuals
Maximum import and export capacity charges	Charges based on agreed capacity for imported and exported flows	Incentive to minimise capacity used to import and export power, meaning on-site generation advantages are present where well matched to site demand.	Not consistent with demand-only charging for residuals

1.2. Net volumetric import and export charges, and maximum import and export capacity charges were seen as implementing residual charges on generation, and therefore were not consistent with our view that residual charges should be levied on final demand users. Maximum import and export capacity charges would also require metering which is not used extensively and may dis-incentivise prosumers from exporting their generated electricity in an inefficient way, or incentivise inefficient storage investment.[2]

1.3. Net volumetric charges were seen to strongly incentivise behaviours that contribute to harmful distortions, overly incentivising load reduction from the electricity networks beyond the extent to which it is efficient. This ability of some users to avoid paying residuals, especially when actions they take to reduce charges do not lower (and often increase) the overall cost of the system means that other users see their proportion of the charges rise.

1.4. Gross volumetric charges were seen to be suitable only for non-domestic users due to metering requirements and potential concerns about intrusion in to a domestic setting. There are in excess of 25 million domestic meters and BEIS figures suggest there are in excess of 800,000 homes with solar PV.[3] For these charges to be applied to domestic consumers, a large change in the metering arrangements would be required for implementation, which is unlikely to be seen as proportionate.[4]

2 Any consumer who also exports to the local grid, either from own production or from stored power

3 https://www.gov.uk/government/statistics/solar-photovoltaics-deployment

4 While consumption from the network is metered, and for some on-site generation, gross generation is metered for Feed-in Tariff (FiT) purposes. There is currently no measurement of on-site consumption. Further, non-renewable on-site generation is often not measured at all at present. Implementation for domestic users this would require significant costs and implementation time, and many people may not find this option acceptable on principle. It would also be extremely challenging to monitor and ensure compliance.

1.5. The basic options considered for reform, that formed the starting point for our analysis were:

a) fixed charges;

b) capacity demand charges – both:

- on used (ex-post) capacity; and
- on available (ex-ante) capacity; and

c) gross consumption charges (for business consumers only).

These options will be referred to as the 'basic' options.

Developing the basic options

1.6. We worked with our consultants, Frontier Economics/LCP to define the basic options as shown in Table 2.

Table 2 The basic options and their characteristics

Basic Option	Characteristics of basic option
Fixed based on historic levels	• Fixed charges per segment based on historic contribution to overall residual. • An option where the revenue raised from a particular segment (in this case a Line Loss Factor Class (LLFC)) is linked to historic levels. This would also be delineated by voltage level, therefore transmission connected and Extra High Voltage (EHV) connected would be discrete groups. • Fixed by historic share means that these charge shares would not update over time, but would not lead to any segmental redistribution. • A single fixed charge for each LLFC segment means equality within segments and attempts to provide an equitable distribution of revenue between segments, with larger users recognised as distinct from smaller ones.
Gross Volumetric charges	• Based on all user's consumption (including on-site generation). • Applies to non-domestic customers (i.e. industrial final demand and larger commercial sites) which includes sites on the high voltage network under the Common Distribution Charging Methodology (CDCM) regime.[5] • A single charge per kWh of electricity consumed on-site, regardless of whether the kWh originated from onsite generation or through being network connected. • Restricted to large business in recognition of the level of intrusion necessary. A high-level assumption of a higher potential for price sensitivity and so higher likelihood of reducing capacity or, less likely, disconnection
Ex-ante capacity charges	• Charges related to user's agreed or connected capacity. • Capacity charge based on individual customer agreed connection capacity, or on a deemed capacity where no explicit agreed capacity exists. • We assume the same connection capacity for all domestic consumers, based on informal discussions with Distribution Network Operators (DNOs) to allocate technical capacity of 18kVa per household. • Small and medium size enterprises (SMEs) without agreed capacity use deemed level of 55kVa per site, based on DNOs submissions of average capacity allocated to such users.
Ex-post capacity charges	• Charges are based on measures of individual peak system usage. • We consider the impact of a measure of single individual peak (which we consider to be the least avoidable form of ex-post charge, as only year round demand management would reduce charges, and capacity use during outages would be measured). • Would require metering capable of measuring peak use.

5 Common Distribution Charging Methodology is the charging methodology for users on the low voltage and high voltage level of the network.

Static distributional modelling

Determining our example user groups

1.7. To understand the impact of the charging options for different types of users, we commissioned our consultants to produce a model to estimate residual charges. This was produced for different network voltage levels, for each of the charging options identified. Using industry data gathered from charging models, Distribution Network Operator (DNO) information requests and data from usage trials, Frontier have provided us with a set of representative network users and how they contribute to the current residual charges, according to voltage levels and LLFC's. Full details of the rational and methods for this use of representative users can be found in Frontier's 'Distributional and wider system impacts of reform to residual charges' report.

1.8. This is supplemented with estimates of the levels of capacity and electricity consumption at each level, allowing us to understand the segmental changes to the distribution of revenues for the different options. To better understand the impact on individual users, representative consumers across the domestic, commercial and industrial sectors were developed with individual assumptions for capacity, electricity consumption (both net and gross) and peak demand.

1.9. This analysis provided a baseline from which the difference in residual charges, that the different charging options we considered, produced. The indicative user charges calculated for charging options, focussed on residual charges only, which currently make up around 15% of a typical user's total bill.

1.10. The full process that was undertaken is explained in the Frontier report, that supplements this consultation and draft impact assessment. As each business is unique, it is not possible to provide representation for all businesses, but we believe this is sufficient to allow proper engagement with this process and understand the potential impacts of the options presented, particularly when combined with the illustrative charges for each network level. We have used the distributional impacts generated by the model, combined with internal assessments against the TCR principles. We then assessed the behavioural impacts of the options, to build up a picture of their likelihood of furthering the TCR objectives and Ofgem's principal objective and statutory duties.

Domestic Users

1.11. Our domestic users (Table 3) cover a range of consumption volumes, on a number of different user groups, and includes the impact of changes on users of various low-carbon technologies.

Table 3 Indicative baseline annual use, and capacity, for domestic users

Segment	User group	Connection capacity (kVA)	Annual gross demand (kWh)	Annual net demand (kWh)
Domestic	Low consumption	18	1,900	1,900
	Medium consumption	18	3,100	3,100
	High consumption	18	4,600	4,600
	Economy 7	18	7,100	7,100
	Solar PV	18	3,100	2,204
	Solar PV with storage	18	3,100	1,918
	Electric vehicles	18	4,622	4,622
	Heat pumps	18	5,651	5,651

Source Frontier 'Distributional and wider system impacts of reform to residual charges'

Commercial consumers

1.12. Non-domestic users (Table 4) are treated as distinct customer classes within the industry models, having their own LLFCs. It should be noted that the smallest commercials currently have similar consumption to the higher consuming domestic users, but under some charging options are likely to be treated differently.[6]

Table 4 Indicative baseline annual use, and capacity, for commercial consumers

Segment	User group	Connection capacity (kVA)	Annual gross demand (kWh)	Annual net demand (kWh)
Commercials	Low consumption	55	10,000	10,000
	High with onsite generation/storage	55	25,000	15,470
	High without onsite generation/storage	55	25,000	25,000
	Light industrial HV-connected	2,000	5,000,000	5,000,000

Source Frontier 'Distributional and wider system impacts of reform to residual charges'

[6] Frontier have termed the smallest SME's as commercials based on consumer feedback. We have termed them as SME's because this is a more commonly used term and does not confuse them with other commercial enterprises.

Industrial Users

1.13. The largest distribution connected sites (Table 5) are connected to the Extra High Voltage (EHV) network. These users currently pay site-specific residual charges for Distribution Use of System (DUoS) residuals which are subject to significant variation. These sites are also liable for triad-based Transmission Network Use of System (TNUoS) charges. Some of these sites may have their own generation, enabling them to reduce their exposure to some, or all, of the triad charges by supplementing their demand from the grid during these periods.

Table 5 Indicative baseline annual use, and capacity, for Industrial consumers

Segment	User group	Connection capacity (kVA)	Annual gross demand (kWh)
Industrial	Extra high voltage-connected without onsite generation/demand management	10,000	50,000,000
	Extra high voltage-connected with peak generation/demand management	10,000	50,000,000
	Transmission connected with peak generation/demand management	20,000	100,000,000
	Transmission connected without onsite generation/demand management	20,000	100,000,000

Source Frontier 'Distributional and wider system impacts of reform to residual charges'

1.14. The largest users on the network are connected to the transmission network. These users are not currently liable for distribution network charges (and we do not propose to change this for the reasons set out in the consultation document) so are only liable for transmission (TNUoS) charges determined through triad periods. To illustrate this, our representative consumers include one who pays the residual charge and one who is currently managing their exposure during Triad periods.

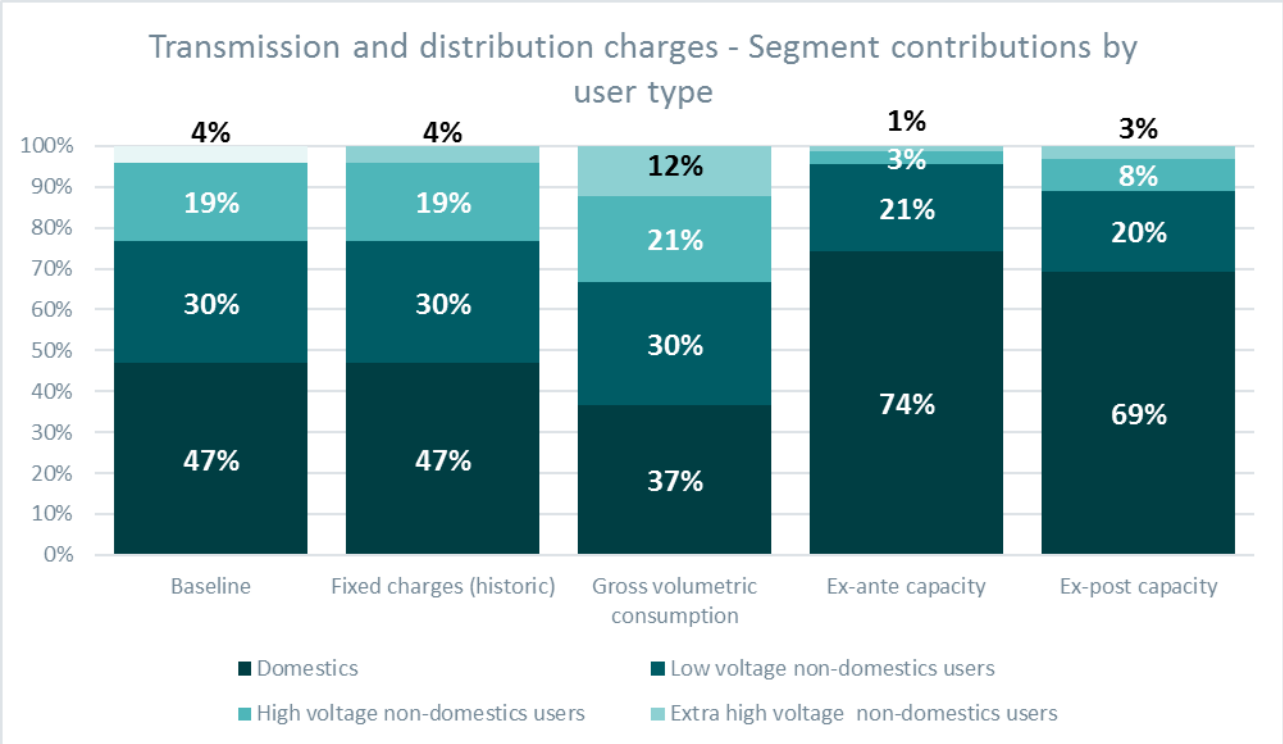
Establishing baseline charges for the segments and user groups, and assessing the change under the basic options

1.15. The following section provides an overview of the baseline charges, and static distributional impacts, of each of our reform options. This shows the changes users could expect to see under the basic reform options. Full details of the process followed to produce the user groups and the individual user group impacts are available in the Frontier report, 'Distributional and wider system impacts of reform to residual charges' which supplements this document. We also carried out internal assessments of the options against the TCR principles of reducing distortion, fairness and proportionality and practical considerations. These were also assessed quantitatively through behavioural assessment and wider systems modelling.

1.16. The high-level redistribution of residual charges can be seen in Figure 1 under each option, compared to the baseline distributions. The cross segment distributions do not change in any of the options.[7] The basic fixed option, which preserves the existing distribution of charges that are seen in the baseline (by assessing the level of charges paid by each LLFC and dividing that revenue equally among the users in that class), leads to no difference in segmental contributions, as it is based on historic revenues. It should be noted that this analysis assumes a one-for-one pass through of the changes in residual charging methodologies. These are charged by the DNOs to suppliers. For most customers, suppliers will be required to pass through these charges to their end customers, but may be unable or unwilling to pass these changes directly through to their customers.

1.17. Figure 1 shows that gross charges allocate substantially more revenues to the non-domestic segments, and charges for extra high voltage and transmission increase the most. Capacity charges, of both the ex-ante and ex-post variety, allocate substantially more revenues to domestic users. For ex-ante charges, this reflects the high level of technical capacity assumed by the DNOs, linked to an ordinary household fuse size, which underpins the 18kVa capacity deemed level. For ex-post, it reflects the high peak use of domestic users and the fact that domestic users make up the majority of users on the network. Further information can be found in Frontiers 'Distributional and wider system impacts of reform to residual charges'.

Figure 1 High level residual charging distribution across segments



[7] Note that this figure does not include the Extra High Distribution Charging Methodology (EDCM) residual revenue, which at £65m amounts to c.1.5% of residual revenues.

1.18. The baseline charges, and the charges under each basic option for each user group, can be seen in Table 6. This analysis uses the Northeast DNO region as an example because the charges for this area are close to the median in most cases.

Table 6 Residual charges under each of the basic options[8]

User group	Baseline	Fixed	Gross	Ex-ante	Ex-post
Domestic - Low	£44	£76	£35	£130	£96
Domestic - Medium	£72	£76	£57	£130	£128
Domestic - High	£108	£76	£84	£130	£159
Domestic - Economy 7	£163	£117	£130	£130	£191
Domestic - Solar PV	£47	£76	£57	£130	£128
Domestic - Solar & storage	£25	£76	£57	£130	£128
Domestic - Electric vehicles	£94	£76	£85	£130	£207
Domestic - Heat pumps	£105	£76	£104	£130	£188
SME - Low	£179	£224	£184	£397	£264
SME - High PV Storage	£204	£224	£459	£397	£369
SME - High no PV	£489	£224	£459	£397	£369
SME - High PV Storage (Larger LLFC)	£204	£1,034	£459	£397	£369
SME - High no PV (Larger LLFC)	£489	£1,034	£459	£397	£369
SME HV	£82,531	£48,847	£91,825	£14,429	£15,944
Industrial - EHV no generation	£323k (median)	£112,542	£469,577	£79,238	£119,851
Industrial - EHV with generation	£26k (median)	£112,542	£469,577	£79,238	£119,851
Industrial transmission connected users with generation	£0	£264,242	£832,794	£75,629	£160,562
Industrial transmission connected users with no generation	£595,161	£264,242	£832,794	£75,629	£160,562

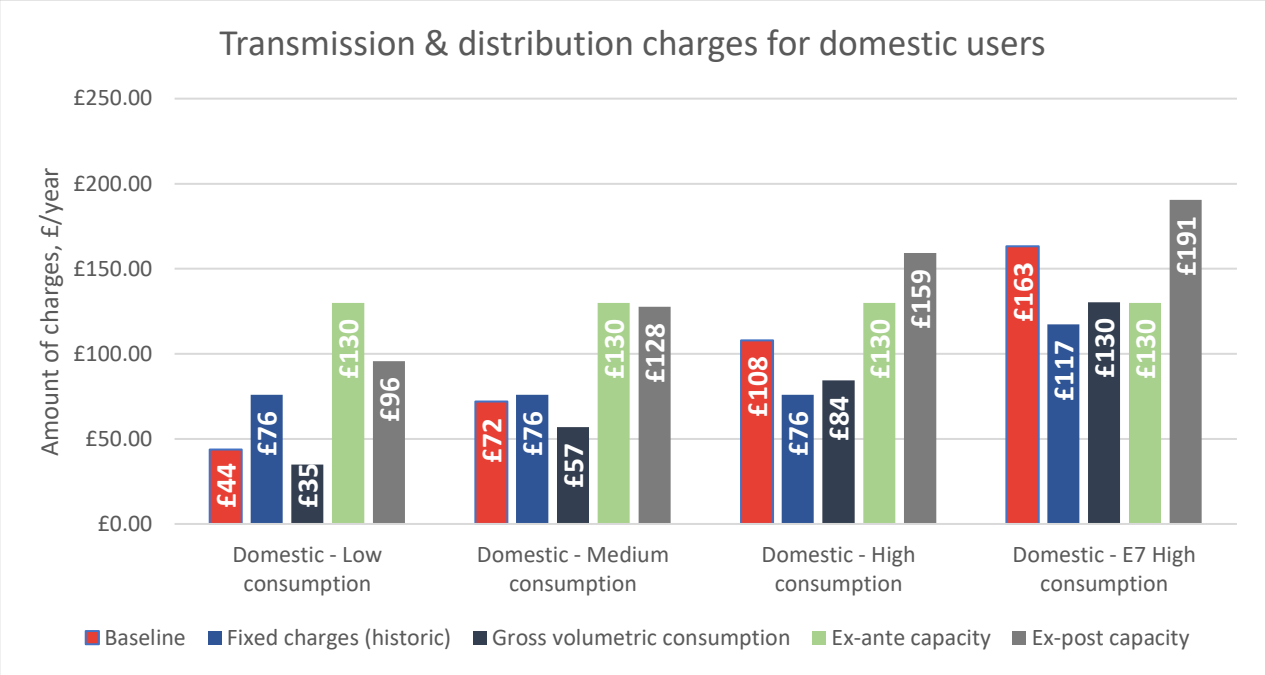
Note: PV stands for photovoltaic panels and Industrial transmission for industrial users connected to transmission networks

1.19. As the baseline figures in Table 6 show, for domestic users, their residual charges are proportional to the volumes of electricity they import from the grid (Figure 2). Currently the user groups with solar photovoltaic panels (solar PV) and those with solar PV and

[8] TNUoS and CDCM have been added together in this table. EDCM values are not included

storage, pay significantly lower charges than those without, because they import less electricity from the grid.

Figure 2 The Northeast as a regional example of changes in domestic residual charges per year



1.20. Our median user, consuming 3100kWh per year, for which they currently pay £72 each year, would see increased charges with capacity charges, but decreased charges with gross volumetric charges. The user with solar PV and storage use the same amount of energy, but as they only import a much smaller amount of this via the network, their charges are significantly lower than any otherwise similar user. There is no cost-reflective reason why this should be the case, as residual charges are not related to the delivery costs of electricity via the network. This is evidence of one user group's reduced charges, leading to an increase in the overall amount of revenue needing to be recovered from others.

1.21. As fixed charges here are based on historic segment contributions, the charges are relatively unchanged for the medium user, whose consumption is close to the group average. This approach leads to the same residual charge for low, medium and high consuming users if they are within the same LLFC (Figure 2). This approach allocates Economy 7 users a separate charge because they have a different LLFC to single rate users. With the exception of ex-post capacity charges, Economy 7 users pay less under the basic options, and their baseline charge reflects the higher consumption we assume for this user group.

1.22. Fixed charges and ex-ante capacity charges, as set out in the basic options, return the same charge for all users within segments, leading to increases for low consuming users. We considered whether this outcome was practical and fair and whether further banding of charges would better reflect different users. These questions remain for our

preferred options, both for domestic users and those connected to the extra high voltage and transmission networks, where the range of users is significant and a single charge, while simple, may be seen as insufficiently equitable for users at the extremes. We have chosen to prioritise charges that differentiate between types of users (e.g. differentiating households from industrial sites) over ones that differentiate users within user groups (e.g. large and small houses).[9]

1.23. Across other user groups, the impacts of charges varied greatly between the basic options. Generally speaking, the ex-ante capacity option allocated significantly less revenue to the largest users at high voltage, extra high voltage and transmission, reflecting the fact that the amount of capacity held by these users is relatively low, when compared to low voltage users as a whole. It also reflects higher load factors, where users can consume significant volumes of electricity while maintaining smaller connections, in contrast to smaller users with low load factors, but where relatively high levels of capacity are held and relatively low volumes consumed. In our modelling, the basic options prevent differences in charges between users with and without onsite generation. This leads to increases for those currently avoiding charges, even if the levels of revenue allocated to the segment decrease.

1.24. A good example of this is at extra high voltage, as shown in Figure 3 below. There is significant variation in the baseline level of charges due to location, and there is substantial variation between those who can manage exposure to residuals using generation and those who cannot. Under the reform options there is no difference between charges for those with or without generation. Gross charging leads to significant increases for these users, reflecting the significant volumes consumed (regardless of whether generation is present or not).

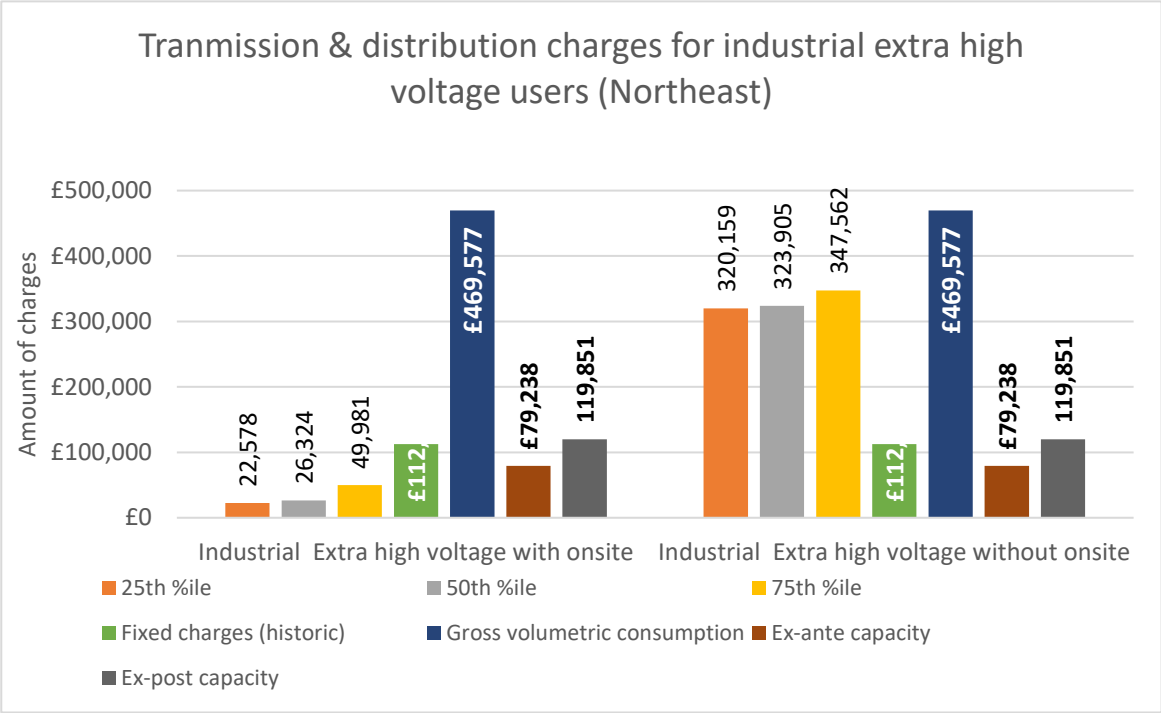
1.25. Ex-ante and ex-post charges lead to significant falls in charges, where users are unable to respond to charging signals, and increases for those who respond. Fixed charges also do the same, however, it should be noted that while gross, ex-ante and ex-post charges will vary with the size of the user (through their final consumption, agreed capacity or peak demand, respectively) the fixed charge will not.

1.26. Fixed charges are the same for all users within a LLFC. There are individual LLFCs for extra high voltage, but for the purposes of charging residuals, all extra high voltage sites would receive the same charge. There are no LLFCs for transmission connected sites, meaning the same approach would be taken as with extra high voltage. As such, this would, in practice, mean there is only one charge for these users, respectively. We understand that extra high voltage sites cover a range from just a few tens of kW capacity up to sites of several hundred MW. Transmission sites are similar covering a range of sites of a few tens of MW up to several hundred. The same charges may therefore seem low or high for users that deviate significantly from the mean for their charging class (Figure 3). Similarly, there may be large changes where users, who have characteristics similar to one type of users but is formally classified as another. An example of this could be smaller microbusinesses, who may have consumptions similar to domestic users, but be classed as small SMEs, and receive SME charges.

9 For details on fairness and equitability for users, see Annex 1 TCR Principles.

1.27. We have found that using LLFCs presents a ready-made means to identify different types of users, but it must be stressed that LLFCs have a specific purpose for a different element of charging (losses in principle) and may not be perfect for allocating residual tariffs. We consider their use simple, transparent and practical but we are seeking views, through this consultation, on whether they are sufficiently granular to produce segments, or whether another method may be more appropriate.

Figure 3 The Northeast as a regional example of changes in industrial residual charges per year



Behavioral Analysis

1.28. Part of Frontier's analysis was to consider behavioural changes that are likely to occur as a result of changes to residual charges. For smaller users, the focus of the behavioural analysis was considering the adoption of low carbon technologies e.g. roof top solar. Larger users have a greater incentive, because of higher charges, to change their behaviours regarding electricity use. This is particularly the case for those users who have invested in plant to actively avoid these charges. This work found (full details are set out in Frontier's 'Distributional and wider system impacts of reform to residual charges') that residual costs alone had very limited impact on the investment of households in low-carbon generation. The take up of electric vehicles (EVs), heat pumps (HPs) and storage was also not impacted by the residual charges, as even under 'high' sensitivity assumptions, there is never an increase of more than 10%. This shows the residual costs as being marginal in technology take-up rates.

1.29. The potential for large users to consider disconnection, after the removal of this incentive, was also assessed as relatively low, and largely related to the presence of existing generation on-site and its contribution to consumption volumes and revenue.

This is broadly similar to our qualitative assessment, which suggested that large users are likely to face scenarios in which disconnection is either impossible or extremely difficult, although some users with particular characteristics might find disconnection achievable and economic.

1.30. These behavioural responses contributed to two further pieces of analysis:

a) The assumptions and baseline levels of charges used to determine distributional impacts. This accounts for the possible changes to user bases that might occur if technologies, that better supported reduction in exposure to residual charges, were to take place; and

b) The design of scenarios, for wider systems modelling, to show multi-year consumer costs and benefits resulting from change.

1.31. In addition to this assessment by Frontier, we also considered how larger users might respond to changes in residual charges.

1.32. The results of this work show that, despite large electricity users reacting strongly to price changes, a change in residual charges alone was unlikely to lead to them disconnecting. They also noted that there were characteristics which either encouraged or discouraged disconnection shown in Table 7.

Table 7 Characteristics of large users and reasons to disconnect or remain connected to the Grid

Characteristics likely to reduce disconnection by large electricity users	Characteristics likely to increase disconnection by large electricity users
Making significant financial gain from exporting excess electricity back to the grid.	Are facing grid connection capacity constraints
Having statutory or legal duties to connect provide electricity to third parties	Have long term site commitments or ownership
Having contractual duties to provide electricity to third parties	Have invested heavily in a specific site
Having distributed generation from intermittent renewable sources	Have access to low cost fuel feedstock or Distributed Energy Resource (DER) surplus from legacy projects
Facing significant financial detriment from electricity supply interruptions	Have organisational policies or publicly declared positions that support DER /renewables

1.33. Our analysis recognises that, for those managing their exposure to residual charges currently, the likelihood of inefficient load reduction or grid disconnection might increase, if their overall bill increases, but concludes the likelihood of disconnection is low overall. Users, who have not been managing their charges, are likely to see reduced residual charges and therefore the likelihood of disconnection is further reduced.

1.34. We also conclude that 'the removal of significant differences between those with and without on-site generation will lead to a more predictable charging regime'.[10] It is, however, noted that by removing the opportunity to avoid charges, it is likely to increase charges for those who, through investments, have signalled their sensitivity to network changes. As such, it is these most elastic users who are likely to respond.

1.35. Our analysis is mindful that change may lead to increased cost pressure on organisations that are exposed to high energy costs. Of particular concern are those organisations that operate in the presence of international competition. We are therefore keen to be mindful of the need to consider the overall burden on individual segments, but also on the burden of additional charges within segments that fall on users due to avoidance by other users, when considering charging reform options.

10 Ofgem's Large User Report

Assessing the options

1.36. Table 8 sets out a summary of our review of each of the basic options. We set out our initial appraisal, covering the distributional impacts seen from the static analysis. These were combined with the findings of the behavioural assessments and our assessments on fairness, proportionality and practicality, and the potential to reduce harmful distortions.

Table 8 The pros and cons of each basic options

Basic Option	Characteristics of basic option	Pros	Cons
Fixed based on historic levels	Fixed at historic segment contributions using LLFC and Voltage Levels	Charge does not change with behaviour, and so has less influence on operation and investments such as installing on-site generation / storage Charges are easy to implement and potentially stable	It could create incentives to disconnect, where charges rise May be perceived as unfair, particularly if they differ from others in their group Potential negative impact to some vulnerable consumers if their charges increase
Gross Volumetric charges	Based on gross volumes for non-domestic customers	Using behind the meter generation / storage to deliver energy will not reduce charge, removing this incentive compared to some other options (particularly capacity based) Potential to avoid major shifts of charges from active users onto others	May distort choice between behind the meter generation and demand side response, or prevent behind the meter generation even where efficient choice. Currently no visibility for suppliers of large behind the meter generation and there is a need for strong compliance - could lead to undeclared and/or unsafe on-site generation
Ex-ante capacity charges	Single per unit capacity charge across all customers based on agreed or connected capacity	Incentivises reducing connection size –possibly through storage / behind the meter generation or energy efficiency measures Relatively low incentive for grid disconnection Potentially perceived as justifiable as you pay for your declared capacity (which you have option to use)	Could reduce demand flexibility Potential an incentive not to use existing capacity on the networks Does not update automatically over time Incentive for users to undersell their capacity requirement Potential for segmental redistribution
Ex-post capacity charges	Single per unit capacity charge on individual peak consumption	Strongly incentivises lower capacity use from the network through behind the meter generation / storage/potentially inefficient load reduction measures, and so impacts operational decisions	Could reduce demand flexibility Charge volatility if demand is unpredictable Demand side response, on-site generation treated differently from grid-connected generation Potential for large domestic increases

		Relatively low incentive for grid disconnection Can be measured for all customers	

Refining the options

1.37. We identified the strengths, weaknesses and variants of the basic options.

1.38. Table 9 shows the results of the key challenges and possible mitigations for each option determined through this distributional analysis. This was included in the overall options assessment and led towards the selection of the two leading options.

Table 9 Key challenges found during assessment of options against the TCR principles

Charge	Key Challenges	Possible Mitigations
Fixed by historic share	Disconnection incentive (as the only option to avoid this charge) Fairness concerns if same charge for significantly different users	Refined option with variable element (see section 1.88) Greater numbers of user bands
Gross volumetric	Data collection and metering complexity	Restrictions to large users only
Ex-ante capacity	Peak load (and capacity) reduction incentive Missing data for some users Fairness concerns if same charge for different users High distributional impact for domestics	Hybrids with variable element Deemed levels for data deficient users
Ex-post capacity	Individual peak load reduction incentive Residual influences operations Metering capability	Hybrids with fixed element Deemed levels for user with basic meters

Key identified refinements

1.39. Following our initial assessment of the basic options, we then set out the proposed policy refinements which could apply to them. These fall into broad categories and apply to multiple options. Each category was assessed for its rationale and consistency with the TCR principles. This led to some refinements being excluded because they appeared to involve arbitrary regulatory judgements which may not be compatible with

the TCR principles, particularly procedural fairness and avoiding distortions. [11],[12] Table 10 sets out the key policy refinements we retained.

Table 10 'Basic option' refinements and their functions

Key Refinements	Function
Two-part tariffs	Charges for all users have two components, e.g. fixed charge with volumetric element
Segment specific charges	Different charges for different segments, e.g. domestic and non-domestic
Alternative allocation methods	Using different allocation and recovery methods, such as capacity charges with the segment revenue split by segment volumes first
Segment residual allocations	Designed segment revenue shares e.g. historic levels
Segment boundaries	Different ways to segment users into groupings of similar users, e.g. by domestic or non-domestic, or by voltage level
Frequency of charge	Annual capacity charges give different incentives to monthly or daily, but add metering and settlement complexity
Deemed assumptions	Changes to the assumptions, made where there is an absence of data, can change the revenues allocated to different groups

1.40. This assessment was carried out to understand whether refined charging options could be created that mitigate some of the less desirable features seen in the basic options. This provided us with a shortlist of options that were considered to provide improvements when compared to the basic options. Alongside this work, a number of other high-level assessments were undertaken to consider whether further work was needed on the large number of possible combinations of charges that could be created using multiple part tariffs, different combinations of allocations and recovery charges, as well as arrangements where different segments were charged in different ways.

1.41. The refined options we determined would merit further consideration are summarised in Table 11. Options with falling or rising blocks and caps, limits and floors were considered excessive or arbitrary interventions as explained earlier, as was the presence of discounts for certain users. These were considered unlikely to be consistent with the fairness or practicality principles of the TCR and are highlighted in the table, in red. Those highlighted in yellow were not considered to have enough benefits to warrant further investigation. Those in green were either taken forward, or were combined with others and taken forward.

[11] e.g. caps and floors, and rates that changed as users increased in size

[12] For example, where groups are defined to separate different types of users, there may be an incentive for users to change their characteristics in order to qualify for one group rather than another, if such action leads to lower charges.

Table 11 Refinements to the basic options and assessment for further investigation

Charge type	Possible refinement	Rationale
Fixed	Fixed with ex-post element	Differentiates users, links to system use
	Fixed with net kWh element	Differentiates users, links to system use
	Fixed by segment volumes	Links to system use, updates with time
	Fixed with charge caps	Limits disconnection risk
Gross Volumetric	Deemed Gross	Overcomes metering gaps
	Declining block rates[13]	Limits disconnection and redistribution
	Gross for wider user groups	Prevents boundary between user groups
Ex-ante capacity	Different deemed levels	Reduces redistribution due to technical levels of capacity
	Domestic capacity bands	Differentiates users
	Declining block rates	Limits disconnection and redistribution
	Ex-ante with ex-post element	Differentiates users, links to system use
	Ex-ante with net kWh element	Differentiates users, links to system use
	Ex-ante set on ex-post usage	Links to system use, updates with time
	Fixed for users for basic metered users	Overcomes metering gaps
Ex-post capacity	Fixed with monthly ex-post element	Less avoidable, links to consistent use of system
	Charge floors	Prevents charges falling below defined level
	Ex-ante set on ex-post usage	Links to system use, updates with time
	Deemed ex-post for basic metered users	Overcomes metering gaps

1.42. The options taken forward were:

- Fixed charges (apportioned by volume);
- Agreed Capacity charges (using deemed levels where appropriate);
- Capacity charges with rolling updates based on use of capacity;
- Fixed charges with ex-post capacity; and

[13] The rate structure for energy supply that the per unit price goes down when energy needs go up. It is offered by large energy consumers.

- Agreed Capacity charge with a net volumetric element.

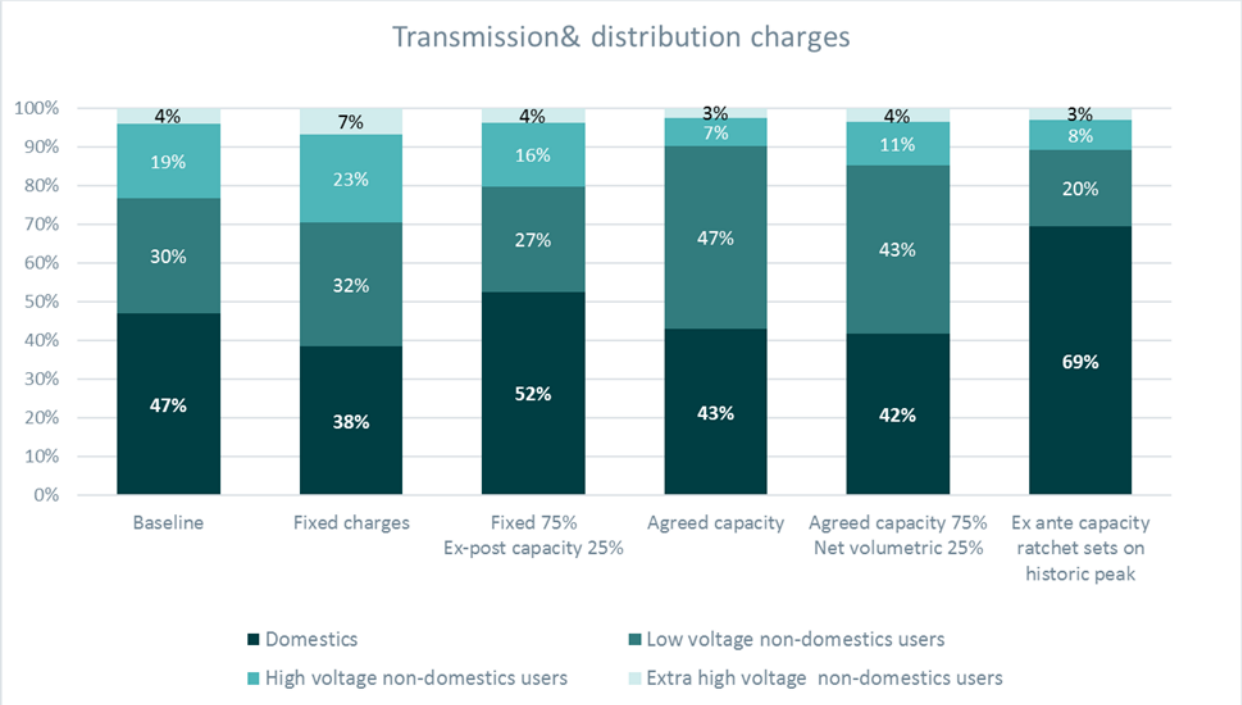
1.43. These five refined options were studied at length and static modelling was produced.[14] Behavioural responses were considered, and wider systems scenarios were mapped to these options and modelled to provide approximate consumer benefit estimates. Detailed proportionality and practical consideration and fairness assessments were also carried out for these options. The results are summarised below and full details can be found in the Frontier Distributional and wider system impacts of reform to residual charges' report.

Segmental distributions

1.44. Figure 4 shows that options emphasising ex-post or historic peak capacity led to a redistribution to domestic and low-voltage connected non-domestic segments of the system, reflecting the peaky nature of domestic users and their usage. The fixed by volume reform option, which look at a segment's contribution to system volumes, allocates slightly more to industrial users, reflecting the high volumes stemming from very high load factors. The ex-ante deemed options lead to a significant redistribution onto low voltage non-domestics, reflecting the high 55kW deemed capacity level that we were advised to use by the DNOs.[15]

[14] No static modelling was produced separately for the rolling updates options as it was not different to the to the Fixed ex post option from a modelling perspective.
[15] Note that this chart does not include EDCM residual revenue, which at £65m amounts to c.1.5% of residual revenues.

Figure 4 The Impacts of refined options on residual charges of different segments[16]

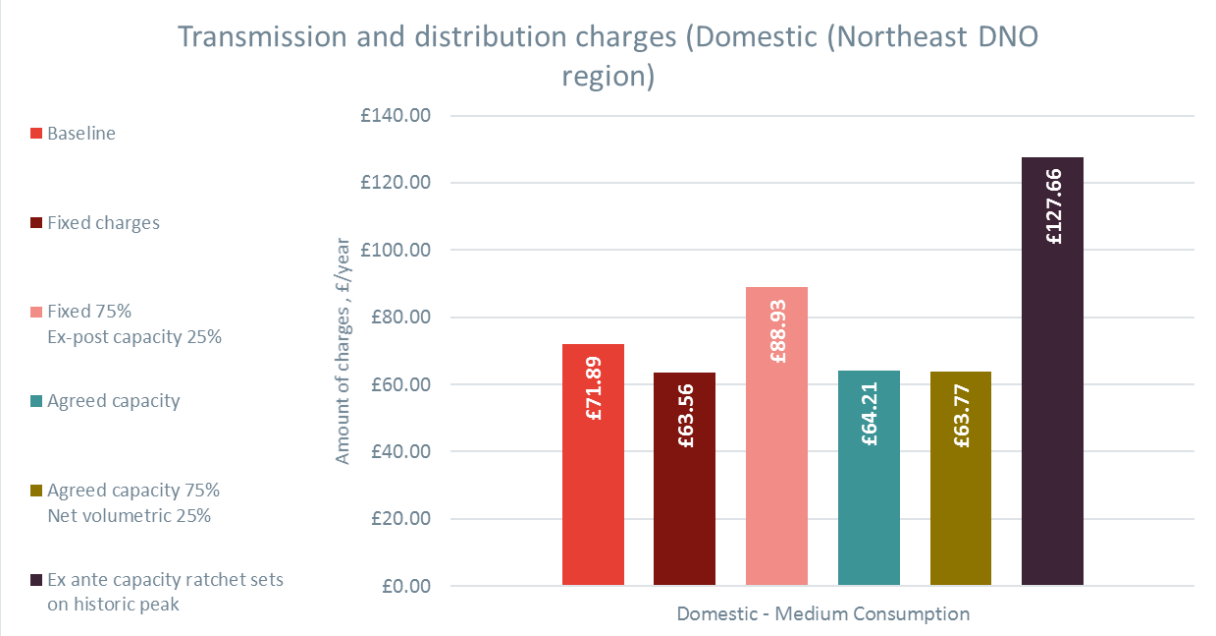


Medium Domestic user's impacts

1.45. Figure 5 sets out the impact on a typical domestic user. Charges fall under both fixed by volume and agreed capacity options, but increase significantly for the options that include ex-post elements.

16 TNUoS and CDCM have been added together in this table and no static modelling was produced separately for the rolling updates options as it was not different to the to the Fixed ex post option from a modelling perspective.

Figure 5 The impact of charges on a typical domestic user[17]

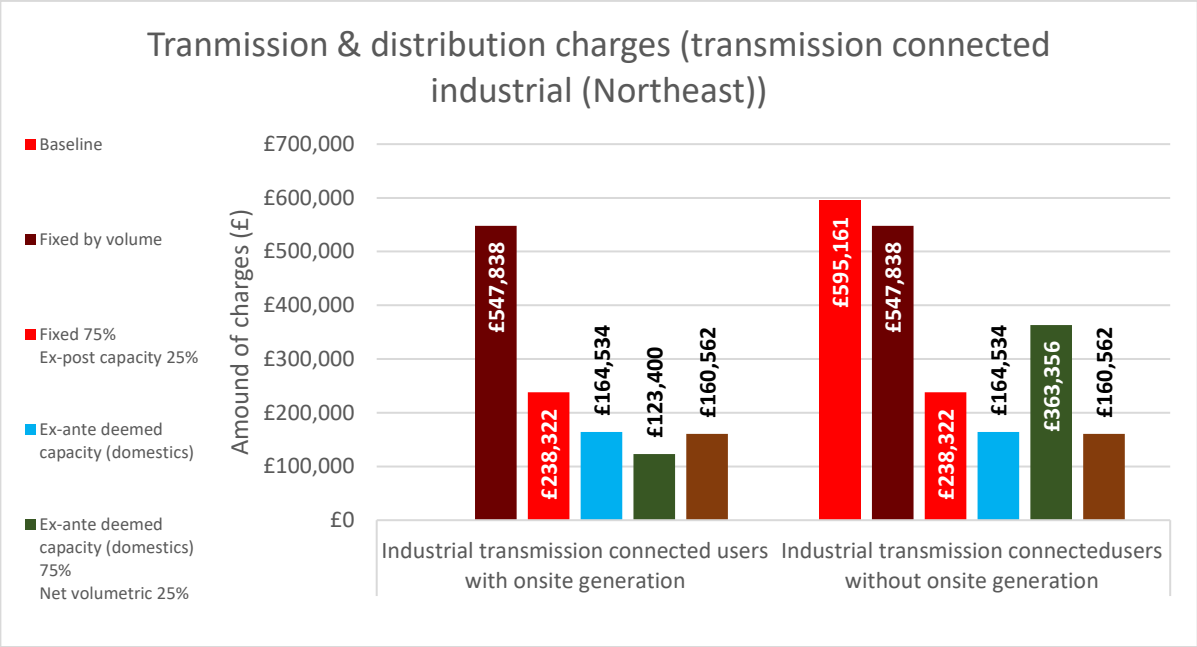


Transmission Connected user impacts

1.46. Transmission connected users, reliant on network generation, see charges reduce under all charging options, although only slight reductions under the fixed by volumes option (Figure 6). This reflects the fact that, while avoidance is reduced (charges can no longer be avoided by replacing generation from the grid) the overall segment contribution increases. This is due to the high volumes consumed by this segment. Ex-ante and ex-post charges lead to significant falls in charges for users who do not manage their triad demand, and increases for those who do. However, while gross, ex-ante and ex-post charges will vary with the size of the user (through their final consumption, agreed capacity or peak demand, respectively), fixed charges will not. This is due to the fact that there is a single charge for extra high voltage connected sites and a single charge for transmission connected sites. As transmission connected sites include a range of consumption, from a few tens of MW up to several hundred, this charge may amount to a significant increase for a site smaller than our indicative 20MW site, but represent a much lower charge for a larger site. As a result, it may have a relatively low impact on the very largest sites, but a greater impact on smaller sites. We are seeking feedback on whether this is compatible with stakeholders' views of fairness and proportionality, and if not, would expect proposals which might better account for scale.

[17] No static modelling was produced separately for the ratchet option as it was not different to the to the Fixed ex post option from a modelling perspective.

Figure 6 The impact of charges on transmission connected users



1.47. A summary of our assessment of these five options, against the TCR principles, is included below (Table 12) and in the RAG (red-amber-green) table (Table 13). This sets our reasoning that Fixed Charges are seen as practical and the least distortive, providing little redistribution between segments, but provides little equity within segments. Agreed Capacity charges are more redistributive, and ex-ante charges require deemed levels for many users, but provide a reasonably good solution to distortions. Some are, however, retained at domestic level. Charges using ex-post data were seen as too complex because this data is not available for a significant proportion of users.

Table 12 Assessment of the five options against the TCR principles

Prioritised refined options	Description	Decision	Summary of Justification
Fixed charge (apportioned by volume)	A fixed charge is calculated for each user segment (based on volume by LLFC) with the split between segments updating each year based on segment net volume. Advantage over the basic option is that it uses updated segment volumes, not historic shares, so is fair and future proof, with low distributional impact. Charge gives equity between segments, but equal charges within segments. Practical, achievable option.	Lead option	Strong theoretical underpinning, allocated by volume and recovered by fixed charges, some small user distributional impacts.[18]
Agreed Capacity charge (using deemed levels for domestics and microbusiness)	Deeming is based on consumption volume bands (e.g. three levels for domestics), otherwise uses Agreed Capacity. Advantage over basic option is a reduction in the redistribution of revenue to domestics, who technically hold a lot of capacity but are very diverse, so do not require the same level of investment, as their technical capacity would indicate. Reduced distributional impact over basic ex-ante capacity. Capacity deemed assumptions agreed using CLNR[19] data from static analysis. Some incentives remain, achievable with deemed levels for some users.	Lead option	Keeps ex-ante charges for larger users but reduces distributional impact by deeming capacity for small users, has significant LV non-domestic distributional impact
Capacity charges with rolling updates based on use of capacity	Multi-year rolling maximum capacity charge updates level with use. Advantage over basic ex-ante option is a reduction in the redistribution of revenue to domestics, as used capacity lower than technical. Advantage over basic ex-post option is a reduced ability to avoid the charge as it is based on multi-year measures. Potentially complex.	Drop	Complexity of both ex-post and ex-ante required, seen as not proportionate to benefits.
Fixed charges with ex-post capacity	Link with existing triad regime, differentiates users in the same band. The use of multiple peaks will provide additional insight. Advantage over basic fixed option is the links to use of system, which adds fairness/legitimacy for users. Advantage over basic ex-post option is a reduced ability to avoid charge as majority of charge is fixed so less avoidable.	Drop	Complexity of ex-post, incentive to manage load retained, arbitrary percentage splits and use of historic revenues less fair.

18 For theoretical information related to charging for networks see annex 3

19 CLNR. *Developing the smarter grid: the role of domestic and small and medium enterprise customers*. (2015).

Agreed Capacity charge with volumetric element	Deeming based on consumption volume bands, with addition of 25% net volumetric element. Advantage over basic option is a reduction in the redistribution of revenue to domestics, who technically hold a lot of capacity but are very diverse, so do not require the same level of investment as their technical capacity would indicate. Reduced distributional impact over basic ex-ante capacity. Volumetric element retains some distortion, but adds equity as higher users charged more than lower users.	Drop	Adds an element of volumetric charge to reduce distributional impact and add equity, but retains more incentives and adds user complexity.

1.48. This final assessment resulted in the two leading options of:

- Fixed Charge (apportioned by net volume); and
- Agreed Capacity charge (using deemed levels for domestics and microbusiness).

Table 13 Advantages and disadvantages of the basic option

Option	Reducing Distortions	Fairness	Proportionality and practicality	Distributional impact
1) Fixed charge, apportioned by volume	Removes existing distortions, introduces none	No scaling with use for domestic	Boundary issues	No distributional impact between segments, but some within
2) Ex ante capacity charge, deemed for domestics and microbusiness	Removes existing distortions	Higher equity due to deeming based on volume	Requires deemed capacity values, and management of capacity values	Lower distributional impact within segments
3) Ex ante with ex-post excess capacity charge	Removes existing distortions but ex-post is avoidable	Deemed for small, therefore fixed	Ex-post element requires major system changes	Domestics pay an increasing proportion of charges
4) Fixed charges (75%) and ex-post (25%)	Removes existing distortions but ex-post is avoidable	Deemed for small, therefore fixed	Ex-post element requires major system changes	Increase for domestics
5) Ex ante (75%), Net 25 (25%)	Removes existing distortions	Higher equity due to deeming based on volume	Requires deemed capacity values, and management of capacity values	Lower distributional impact within segments